

# SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.  
VOL. XV. No. 372.

NEW YORK, MARCH 21, 1890.

SINGLE COPIES, TEN CENTS.  
\$3.50 PER YEAR, IN ADVANCE.

## AN IMPROVED TRUCK FOR ELECTRIC CARS.

THE improved motor-truck for electric cars shown in the illustration on this page is designed to prevent, or at least to greatly lessen, the oscillating motions of cars with short wheel-base, such as all four-wheeled street-cars must of necessity be. It is also intended to strengthen the ends of car-bodies by providing additional support nearer the ends of the car than is possible with the usual truck.

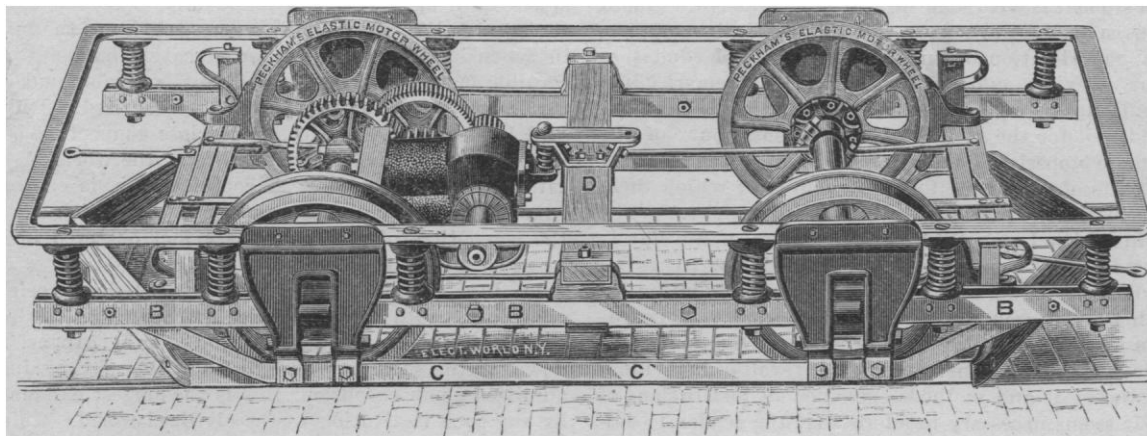
The main double side-bars, marked *B* in the engraving, support, by means of the twelve springs shown, the upper frame upon which the car-body rests. The side bars are in turn supported by the cantilever trusses *C*, which are suspended from the journal-boxes by malleable iron yokes, to which the side-bars are securely fastened. The electric motor is suspended by a bolt and spring from the hanger on the cross-bar *D*. The hanger is arranged to support either one or two motors. A part of the side-bar *B* is detachable, so that it may be unbolted and taken off

demonstrate their efficiency. The axles are made of fibrous wrought steel, and are provided with enlarged bearings and screw threaded collars.

These cantilever trucks, which are made by the Peckham Car Wheel Company of this city, are now in actual use on many electric street-railways in this country, and the companies using them are well pleased with their many points of superiority over trucks not specially made for motor service.

## THE INFLUENCE OF LEARNED INSTITUTIONS UPON THE PROGRESS OF MODERN SOCIETY.<sup>1</sup>

It is sometimes urged, as a criticism upon institutions of higher education, that many men of intellectual eminence, subjected to their training, have acknowledged small obligation to it. One recalls, as an example of this, the grotesque picture of the University of Edinburgh, drawn by the satirical humor of Carlyle in "Sartor Resartus:" "Had you, anywhere in



THE PECKHAM CANTILEVER MOTOR-TRUCK FOR ELECTRIC CARS.

when it is necessary to remove the armature for repairs. No other part of the truck need be disturbed when repairs to the motor are needed.

These trucks are equipped with compound lever brakes of great strength and simplicity, which, in quickness of action, are claimed to be much superior to the brakes generally used on car-trucks.

A peculiar feature of these trucks is that they are equipped with elastic wheels, the parts of which they are composed being interchangeable, so that worn or damaged parts may be readily and cheaply replaced. The wheels have malleable iron hubs, which are forced on the axles by hydraulic presses at a pressure of thirty-five tons to the square inch, so that there is no possibility of their ever working loose. The wheel webs can be removed and replaced by any ordinary workman, without the aid of special machinery, and without removing the motors from the axles. Tubular rubber cushions are inserted between the hub and the web, supporting the axles and motors, and relieving them from shocks, and lessening the tendency to crystallization of the iron. The journal-boxes are dust-tight and self-lubricating, and have been in use on various roads a sufficient length of time to

Crim Tartary, walled in a small enclosure; furnished it with a small, ill-chosen library; and then turned loose into it eleven hundred Christian striplings, to tumble about as they listed, from three to seven years; certain persons under the title of professors being stationed at the gates, to declare aloud that it was a university, and exact considerable admission fees, — you had, not indeed in mechanical structure, yet in spirit and result, some imperfect resemblance of our High Seminary." Mr. Darwin has furnished us a more recent instance, declaring, that, during the three years which he spent at Cambridge, his "time was wasted, as far as the academical studies were concerned," — "sadly wasted, and worse than wasted." It is not difficult to adduce unflattering estimates like these in considerable number from men distinguished both in letters and in science. Literary genius has been particularly impatient of academic methods. Acquaintance with the thought of the past, indispensable to those who would enlarge the area of exact knowledge, is less necessary to production in pure literature;

<sup>1</sup> Address delivered on the fourteenth anniversary of the Johns Hopkins University, by Professor E. H. Griffin, dean of the college faculty, Feb. 22, 1890.

and accordingly some of the greatest masters in this department stand outside of all scholastic association, while others, who have passed through the ordinary discipline, have failed to discern its advantage. It is in no small degree disappointing to note the relation in which so many of our English poets have stood toward the established educational system. They are, no doubt, a "genus irritabile," somewhat likely to re-act against methods intended for the ordinary mind. Yet we do not like to add to Shakspeare, Pope, Burns, Scott, Keats, and the many others who accomplished their work without aid from learned institutions, so many critical and dissatisfied recipients of that aid: such as Shelley, prematurely dismissed from academic privileges; Byron, Goldsmith, Swift, who perhaps deserved to be; Southey, who declared that of all the months of his life those passed at Oxford were the most unprofitable, — "All I learned was a little swimming and a little boating;" Wordsworth, who showed his contempt for the ceremony of graduation by devoting the days preceding the final examinations to the reading of "Clarissa Harlowe;" even Milton, the most learned of our poets, whose discontent with his alma mater led him to speak of Cambridge, in his "Reason of Church Government," in this wise, "As in the time of her better health, and mine own younger judgment, I never greatly admired her, so now much less."

Nor is it the more strictly imaginative departments of literature alone that have been largely non-academical in their spirit. The fragment of autobiography in which Gibbon has given us so vivid a picture of his intellectual life comments with unsparring severity upon the learned body intrusted with his education: "To the University of Oxford I acknowledge no obligation: and she will as cheerfully renounce me for a son as I am willing to disclaim her for a mother." His great contemporary, Hume, owed so little to scholastic influences that the bare fact of his residence as a student is with some difficulty established. Adam Smith devotes a well-known passage of the "Wealth of Nations" to a consideration of public endowments of education from a point of view sufficiently indicated in remarks like these: "The discipline of colleges and universities is in general contrived, not for the benefit of the students, but for the interest, or more properly speaking for the ease, of the masters. . . . Those parts of education for the teaching of which there are no public institutions are generally the best taught." The low esteem in which Locke held the curriculum of his day is stated, expressly or by implication, in each of his writings on education. Francis Bacon criticised the learned foundations of his time on historical grounds in the "Advancement of Learning," and on grounds of theory in his "Novum Organum."

It is needless to multiply instances of this revolt of individual genius from the ideas and methods embodied in institutions of education. It seems necessary to admit that the academic discipline has not been very successful in dealing with the highest order of minds. Yet, obviously, there are various things that may be said in reply to such an allegation. It does not follow, because the work of a great man seems to himself or to others to have been uninfluenced by his early education, that it really was so. We sometimes forget the source of impulses that have been of great consequence to us; and it is not difficult to show, in the case of some distinguished critics of the educational system, that their obligations to it are much greater than they suppose. All human things have periods of relative decline and inferiority, which it is not just to treat as representative. Some of the severest strictures proceed from men who happened upon evil days, and in such cases the exceptional character of the time should be taken account of. During the eighteenth century, for example, the English universities were unproductive. Many of the professors treated their positions as sinecures, and gave no instruction. The story goes that one of the non-resident professors, subjected to the cruel hardship of a journey four times a year for the drawing of his salary, who had made various attempts to induce the authorities to forward the stipend, at last discovered a statute which obliged them to do so, and thus succeeded in absolving himself from the solitary function which he had ever been known to discharge. It is no

wonder that the indignant comments of the author of the "Wealth of Nations" were provoked by an administration of a public trust under which such abuses were possible. So far as there is any incompatibility between provision for the original and creative mind, and due consideration for persons of inferior endowment, it may with some reason be maintained that the latter is the more important duty. Genius can take care of itself; it will not suffer its path to be too narrowly marked out: it is the man of average powers who needs instruction and direction. Society may be better served by an educational regimen adapted to the great mass of those subjected to it than by one higher in intellectual quality, but narrower in the range of its application. We must not allow too great weight to the fact that so many distinguished names can be cited in criticism of methods of education. Such criticisms are often unfair as to the matter of fact, withholding acknowledgments that ought to be rendered. Just as applied to a particular time, they are often unjust as general propositions. The distinction which ought always to be kept in view between the ordinary mind, for which systems of instruction are largely designed, and the exceptional mind, which is in great degree a law unto itself, they often disregard.

I have thought that it might be suitable to the occasion which brings us together, if, instead of discussing a theme of more specific character, which might not be of interest to us all, I were to remind you, through a few illustrations, how potent and effective the influence of learned institutions has been upon the progress of modern society. The conception of scholarly life as remote from practical things is sufficiently common to make it well sometimes to enter protest against it; and however little influenced we may be by derogatory estimates, such as have been referred to, an occasional resurvey of salient facts of academic history cannot be without value. One who considers how hard it is to name an important movement of thought or life, since society emerged from the middle ages, in which institutions of higher education have not been a discernible factor, will understand how honorable and dignified is the learned tradition which we have inherited. "I have felt," said Frederick D. Maurice, "the close connection between the learning of the scholar and the life of the world." The realization of this, as a personal consciousness, is one of the most ennobling and invigorating experiences of which one is capable; the perception of it, merely as a fact observed in history, is by no means unimportant.

In June, 1888, the University of Bologna celebrated the eight hundredth anniversary of its founding. Unless the succession of teachers said to be traceable at Athens, from Plato down to the suppression of Pagan philosophy by Justinian, be admitted as an exception, this is the longest existence attained by any such institution in the civilized world. This length of time takes us back to that early awakening of the intellect of Europe which has been happily termed the "Roman Renaissance." Various influences contributed to make this period of the twelfth and thirteenth centuries one of new life, — Mohammedan civilization, acting through the Crusades and the Saracen conquests, awakening an interest in physical science, bestowing upon western Europe important portions of the philosophy of Aristotle; the commercial enterprise of the busy Italian cities, creating wealth, introducing refined tastes and habits, developing political relations and ideals before unknown; the resuscitation of ancient philosophy, under the direction of the Church, expressing itself in the speculative and dogmatic movement known as scholasticism. The early universities were the product of these pregnant influences. In their origin they were essentially popular; not established by bounty of king or patron, but rising, without preconceived plan, in response to recognized needs, around the persons of famous teachers.

The most characteristic of the intellectual tendencies of the age was the scholastic philosophy, and it was only natural that the newly founded schools should for a long period of time be mainly devoted to its promulgation. Mr. Hallam, writing scarcely more than fifty years ago, declared that he knew of only one Englishman, since the revival of letters, who had

"penetrated into the wilderness of scholasticism." When one remembers that Thomas Aquinas is the accredited exponent of the theology of the Roman Catholic Church, this seems hardly creditable to English scholarship; nor is it to our credit that the only idea which so many persons have of these philosophers and theologians of the middle ages is derived from the grotesque and silly discussions in which they are popularly represented as delighting. But the dispute as to the nature of universals, which has been the special occasion of the cheap ridicule visited upon them, is not a mere word-play. Its historical genesis and its intellectual affiliation are in the concepts of Socrates, the ideas of Plato, the forms of Aristotle. However alien in spirit and form to the Greek philosophy, scholasticism is its continuation, and nominalism and realism are only the mediæval way of expressing the antithesis of sense and reason, phenomena and noumena, the empirical and the ideal, which, under one name or another, appears in every age of human thought. That this antithesis should have taken a theological form was only natural under the circumstances then existing: in the absence of a knowledge of nature, there was little else to philosophize about, except the data furnished by the Scriptures. It is easy, no doubt, to blame the scholastic thinkers because they did not adopt the inductive method as expounded by modern authorities; but we all know that men must be judged by the standards of their time, and it is certain, that, in its best period, scholasticism was immensely stimulating and influential. We cannot easily understand how these dry and subtle abstractions of logic and metaphysics could have been so interesting; but we know that the old curriculum, inherited from the declining days of the empire,—the trivium and quadrivium,—was abandoned on all sides for this new instrument of discipline and culture; that admiring pupils flocked in vast numbers to listen to masters like Abelard and Scotus; that even the street brawls of the students turned on the issues between the nominalists and the realists. One can have little of the historic spirit who supposes that these great results were accomplished by what Erasmus contemptuously described as "quibblings about notions, and relations, and formalities, and quiddities, and haecceities." This mediæval philosophy and theology was a genuine expression of the human mind, as good a theory of the universe as the times made possible.

The number of eminent men who taught in the schools of England, France, and Germany during the predominance of scholasticism was by no means small. Such men as Albertus Magnus, Thomas Aquinas, Duns Scotus, William of Occam, would command respect in any age of the world. The greatest of them all according to modern standards, Roger Bacon, we can hardly regard as a product of the spirit of his time so much as a protest against it; and we find in his case, as in that of others, that powerful influences in behalf of intellectual and spiritual freedom proceeded from schools of scholastic learning. Few movements in English history have taken deeper hold upon the masses of society than that of Wycliffe, the centre of whose activity was at Oxford. At the reforming councils of Constance and Basle the deputies from the universities were conspicuously independent; John Huss was supported by the influence and enthusiasm of the University of Prague. Thus in this age anticipations of a new era of human thought appeared. It is to the honor of the early universities of Europe that they were produced by this first intellectual awakening of the modern world, and that they so effectively contributed to it.

The great defect of the intellectual life of the middle ages was that it had not at its command sufficient material of knowledge. In keenness and subtlety, and in constructive ability, the mediæval thinkers have perhaps never been surpassed; but a far wider range of facts was necessary, that these powers might be profitably employed. The revival of ancient learning, therefore, which, beginning at least a century earlier, spread so rapidly throughout Europe after the middle of the fifteenth century, was a natural and indispensable step in the development of thought. It restored the continuity of history; it made antiquity and classic culture again objects of knowledge.

The relation of schools of learning to this eager study of the

past was modified by a variety of circumstances. In Italy, where the passion for classical studies was earliest and most intense, private patrons played the most prominent part in the movement. The collection and transcription of manuscripts, the formation of libraries, the encouragement of learned men,—these services were more munificently rendered by powerful families like the Medicis, by Popes like Nicholas V. and Leo X., by the academies which sprang up in all the leading cities, than by the universities. Of them—in Italy and in every other country—the scholastic philosophy had possession. It is not strange that everywhere it declined to yield its ground. Within limits, the resistance to new methods and new materials of thought, of which the history of education furnishes so many examples, may be admitted as reasonable. Institutions stand in historical relations to the past and to the future, and must act in view of these, making sure that a given change is wholesome before sanctioning it. But the conservative impulse has ordinarily been in excess: habit and sentiment and vested interest have made change more difficult than the public good would dictate. In particular, effete and outworn disciplines have always offered bitter resistance to competitors. The phase of scholasticism which had become prevalent in the fifteenth century combined a strenuous assertion of orthodoxy with fundamental scepticism. The nominalism of William of Occam denying objective validity to general notions, making them mere words or names not answering to reality, carried with it, of course, the consequence that reasonings founded upon general terms are invalid; that no conclusions can be reached by rational argument; that no tenets of theology or philosophy are rationally demonstrable; that faith and the authority of the Church are the foundations of belief. We cannot wonder that a mode of thought so suicidal, which renounced all natural and verified knowledge, should have recognized an irreconcilable opposition between itself and a broadly human and rational movement like the revival of learning.

It must be remembered, also, that humanism passed into various extravagances which might well awaken the alarm of those who adhered to the ancient faith. Even so ardent a friend of the new learning as Erasmus dreaded the results of its importation into the north. "One scruple still besets my mind," he said, "lest under the cloak of revived literature Paganism should strive to raise its head." How largely a refined and sceptical Epicureanism pervaded Italian society at the time of the classical revival, the art and literature of the period abundantly testify. The cynical frankness with which even high ecclesiastics avowed their unbelief is something startling. The theoretical preference of Paganism to Christianity was not uncommon. "Christianity," said Machiavelli, "teaches men to support evils, and not to do great deeds." It must be admitted that the opposition of the academic adherents of scholasticism was not wholly without excuse.

It would, however, be a mistake to suppose, that, even where the traditional influences were strongest, schools of learning were without share in this decisive and critical movement of human thought. The opposition of the existing authorities was in some cases avoided through the expedient of founding colleges. Thus through the institution by Francis I., in 1531, of the Royal College of Three Languages, the University of Paris, a stronghold of the old dialecticians, became an important centre of Greek and Hebrew scholarship. This expedient was much employed by the patrons of the new learning in England. The preponderance of the colleges in the English university system is largely due to the fact that so many sprang into being, or into a more vigorous life, at this time, as instruments of the new culture. Nowhere was the classical revival more effectively promoted than in the English universities. There are few chapters of literary history more fascinating than that which, beginning, let us say, with the gift of classical books at Oxford by Shakspeare's "good Duke Humphrey" about 1435, and ending with the death of Sir Thomas More in 1535, should indicate the leading events and personages of this century of intellectual revolution. The prevalence of Greek scholarship at Oxford and Cambridge is often attributed to the influence of

Erasmus; but there is little doubt that, upon his first visit, he found there attainments quite equal to his own. The encomium of Erasmus upon his English friends has been often quoted: "When I listen to my friend Colet, I fancy I am listening to Plato himself. Who but must admire Grocyn, who is nothing short of a complete encyclopædia of knowledge? Did ever any one possess such taste, so acute, polished, and searching, as Linacre? Has nature ever produced a mind gentler, sweeter, or more richly gifted than that of Thomas More?" The bantering compliment which Erasmus paid More illustrates the delightful intellectual sympathy which united this remarkable body of men to one another. He entitled his famous work, composed at More's house, the 'Praise of Folly;' the Latin words containing a play upon his host's name, *Encomium Morie*. The thoroughness with which the new culture took possession of the centres of English education is indicated in the literature produced in the succeeding generation. The Elizabethan dramatists were nearly all, except Shakspeare, university bred: they often use their classical knowledge with indifferent judgment and taste, but they make it a prominent element in their work. Shakspeare's classical allusions need not be explained by denying his identity: intercourse with his university trained contemporaries sufficiently accounts for them. Much of the interest of this early group of scholars was centred in the elucidation of the Scriptures. Colet lectured at Oxford on the Epistles of St. Paul: Erasmus worked at Cambridge on his edition of the Greek text of the New Testament. The practical aims and the moral earnestness of the English revival of letters distinguished it from that of Italy, from which it took its origin, and rendered it influential upon the higher life of the nation.

The leaders of German humanism were, if possible, more interesting in personal traits than their English co-laborers. Agricola, Reuchlin, Ulrich von Hutten, Melancthon,—these names suggest a variety of character and achievement peculiarly attractive. The development, however, of the movement in Germany was cut short by the advent of the Reformation. This had been foreseen by Erasmus, who had from the first looked with little sympathy upon Luther. A typical man of letters, his chief concern was for literature, the interests of which he would not jeopardize by theological disputes. But the extent to which the classical revival had leavened the thought of the universities may be seen in the fact that the Reformation derived from them its chief impulse. This great movement of faith and conduct was pre-eminently academical in its character. It was not in origin a popular revolution, but a learned one: the study of Greek, pursued for the sake of scriptural interpretation rather than of merely elegant accomplishment, was its inspiration. Whatever view one may take of the German Reformation, it must be conceded that institutions of learning have rarely acted upon society with greater effect than did universities like that of Wittenburg, which first encouraged humane studies, and then used them as instruments of social change.

In 1612, Descartes completed his studies at the Jesuit School of La Flèche. The account which he gives us of his education shows how largely the classical learning had then been accepted by the historical successors of its old scholastic adversaries. If we take the fall of Constantinople as an approximate date for the beginning of the movement, and consider that the Jesuit ideas of education were fairly in operation by the beginning of the seventeenth century, a period of about one hundred and fifty years would seem to have been occupied in winning recognition for the new learning. The magnitude of the interests involved in this momentous intellectual change may explain its slow accomplishment.

The term ordinarily applied to the intellectual awakening of the fifteenth and sixteenth centuries accurately describes its character. It was a renaissance, a revival of the past. It is evident, that, unaccompanied by any other influence, this reinvigoration of the sentiments and ideas of antiquity was an inadequate impulse and basis of civilization. No age can afford to content itself with what has already been. It is difficult to overestimate the importance, as an element in the formation

of modern society, of the new studies, which, after the force of the renaissance was in a measure expended, attracted the best thought of the time. "The fifteenth century," it has been said, "restored the broken links of time; the seventeenth unveiled space. The former had shown to man his place in history; the latter was to assign him his place in nature."

The great age of physical discovery, beginning about the middle of the sixteenth century, but falling mainly in the seventeenth, was distinguished above all preceding eras by independence of the past. No generation of thinkers has ever appeared which derived so little from its predecessors as that which, acting concurrently in each of the leading countries of Europe, laid the foundations of modern science. It is significant that so many of the great men of that epoch interested themselves about the question of method. Bacon wrote a new Organum, discussing the laws under which the object is to be known, as the Organum of Aristotle had discussed the laws under which the subject thinks. The first important work of Descartes was the "Discourse on Method," reversing the procedure of Bacon, and seeking the knowledge of effects through their causes. Pascal's fragment on method is well known. Spinoza, Leibnitz, Hobbes, Locke, — their common characteristic is that they begin with first principles, and manifest an almost unprecedented degree of intellectual independence. It would hardly be expected that an era so self-reliant and so original would have much concern with the traditions and institutions of previous learning. Yet the investigation of nature which created physical science in the seventeenth century founded itself at first upon what had been done in the past. Copernicus evolved his system after an exhaustive study of the various astronomical systems of the ancients. All the discoverers who co-operated in giving this new direction to men's thoughts were trained in schools of education; most of them filled professor's chairs. It is an interesting fact that so many who have contributed to scientific thought have been teachers. This was noticeably the case at the originative epoch of the seventeenth century: Galileo was a professor at Pisa and Padua, Kepler at Prague, Torricelli at the Florentine Academy, Newton at Cambridge. The founders of modern science were indebted to the universities of their day for the equipment of knowledge, without which, novel as were their methods and results, they could not have done their work. Nor, since their time, have contributions to knowledge in this department been often made by men who have not enjoyed the advantage of regular education. A man of letters may dispense with this: it is not necessary that he be widely familiar with the productions of the past. A man of science must know what has been accomplished by his predecessors: the subjects with which he deals have a rigorous continuity of development. Eminent inventors have often been imperfectly educated; but the originating thought, which makes invention possible, comes from a well-furnished mind. Of course, this is more and more the case as experimental methods are developed. The perfecting and multiplication of mechanical aids to investigation, the founding of laboratories and museums and libraries, tend to concentrate activity at points where these facilities are furnished, and thus make the service of learned institutions increasingly indispensable. As the philosophical and theological element in modern thought goes back to the universities of the twelfth and thirteenth centuries, which were produced by it; and as the humanistic and classical tradition finds its origin largely in the learned schools of the renaissance,—so the scientific factor is, even more distinctly, academic in its history. Since the study of nature requires acquisitions and facilities which cannot be commanded by the isolated individual, and must always demand associated and organized endeavor, we see how enormous is the indebtedness of the industrial and commercial civilization of the modern world to institutions which it sometimes thoughtlessly considers unpractical.

In consideration of the sacrifices and sufferings of the citizens of Leyden during that memorable siege whose heroic and picturesque incidents have been made familiar to us by Motley, they were offered by the states of the Netherlands their choice

between immunity from taxation and the establishment of a university. With a foresight which has been rarely paralleled, they chose the latter, and the University of Leyden was accordingly founded in 1575. To this seat of learning, during the years immediately following, came, as teachers and students, a remarkable body of men. One of the earliest professors was Lipsius, an industrious and prolific scholar, for the honor of whose adhesion Protestants and Roman Catholics contended, the latter finally prevailing. To make good this defection, Joseph Scaliger was called, descended from the princely house of Verona, whose tomb all travellers remember, possessed of a wonderful memory, such as, in these days when memory is a lost art, seems scarcely credible, but with still better title to remembrance in the fact that he was the first to form the conception of the science of historical criticism. His conjecture that the Chronicle of Eusebius must originally have consisted of two books, and his conjectural restoration of the lost one, subsequently confirmed in the main by its discovery, must rank as one of the most noteworthy triumphs of historical imagination. Salmasius was another of the teachers at Leyden, in reply to whom Milton composed his "Defense of the People of England;" whose abusive personalities toward his antagonist are equalled only by those of that antagonist toward him; in regard to which, however, it must be admitted that Milton was the aggressor, since, desiring to render his opponent ridiculous, Milton describes him, in graceful allusion to the supposed ascendancy of Madame Salmasius over her husband, as "an eternally speaking ass, ridden by a woman;" to which polite characterization the Dutch scholar retorts with various amiable epithets, such as "puppy," "silly coxcomb," "unclean beast." Such, couched in irreproachable and sonorous Latin, are some of the pleasant compliments which the controversial ethics of that day did not condemn. Grotius was another of the famous men produced at Leyden, a philosophical jurist of Christian temper and of varied learning, often spoken of as the founder of the modern science of the law of nations. Arminius was a student at Leyden, whose name survives in polemical theology, the seriousness of whose departures from Calvinistic orthodoxy would not, I fear, be altogether appreciated, were I to recount them in this place. These and many other distinguished men gave the University of Leyden European celebrity. "In the Batavian Netherlands," says Sir William Hamilton, "when Leyden was founded, erudition was at a lower ebb than in most other countries; and a generation had hardly passed away when the Dutch scholars of every profession were the most numerous and learned in the world." The burghers had made a good bargain; the fame of their city was carried all over Europe by the fame of its university; they got good return for the taxes of which they were not relieved. We may perhaps think of a city of our day, known far and near through the work of its university, and may possibly regret, that, in the matter of the taxes, the parallel fails to be complete.

Equally signal examples of the influence of learned institutions upon the general welfare of the communities in which they are, might be easily multiplied. In 1807, when Fichte delivered his "Addresses to the German People," his voice often drowned by the trumpets of the French troops, setting forth his idea of a common education as the basis of a common nationality, the political condition and prospects of Germany seemed well-nigh hopeless. The humiliations suffered at the hands of Napoleon were not so discouraging as the fact that these did not seem to rouse a united national spirit. The brilliant literary production which marked these years of disaster seemed to show that the intellectual activity of the people was without relation to their political life. We can now see the far-sighted wisdom of the declaration of Frederick William III., in accordance with which the University of Berlin was founded, that the State must repair its outward losses through the development of its spiritual energies. The connection between the educational and the political history of Germany during the present century, no one can overlook: it was the intellectual and moral conditions created by the work of its universities which contributed in no small degree to make the united and

triumphant empire possible. We sometimes regret the multiplication of colleges in our own country; but, whatever evils have attended it, we must not forget that every one of these institutions has been a centre of enlightening and civilizing power.

It is remarkable how many movements which have become popular and widespread have originated in select circles of men gathered in academic relations. What was it which restored to Christianity its influence upon the English nation, after it had been so far lost that Bishop Butler declared, in 1736, "It is come, I know not how, to be taken for granted by many persons that Christianity is not so much as a subject of inquiry, but that it is now at length discovered to be fictitious"? The distinguished apologetic writers of the period contributed little to this result. It was the little company of Oxford students, contemptuously stigmatized as "Methodists," who wrought this moral and social transformation. Reformations in religion have ordinarily proceeded from institutions of learning, but reformations of all sorts are very likely to have this origin. The reason is because the element of ideality is more largely present in such communities than anywhere else, because things are judged in the light of principles more dispassionately and disinterestedly by minds engaged in the pursuit of truth than by persons absorbed in the ordinary pursuits and rivalries of life. The most hopeful appeal in behalf of any interest of human progress is to those who are for the time removed from immediate connection with the existing order, whose enthusiasms are fresh, unselfish, and responsive. One can hardly conceive an atmosphere more congenial to all high inspirations than that which pervades those select circles of young men not rarely gathered in our institutions of education.

Let me recur, in conclusion, to the expressions of criticism and discontent of which I spoke at the beginning, in order briefly to raise the question whether these are likely to be as sharply urged hereafter against present methods as they now are against those which have preceded. There are, as it seems to me, many reasons for believing that the educational work of our time is indefinitely better than any in the past.

The various intellectual interests are harmonized with one another to a greater degree than at any previous time. Scholarly activity is not predominantly determined in any one direction. The legitimacy of all spheres of knowledge is admitted. No one of any authority constitutes himself the partisan of one discipline as against another. Specialization, no doubt, tends to narrowness of view; but this tendency is counteracted by a profounder realization of the unity of knowledge, leading us to understand that every thing in some sort involves and leads to every thing else. Provision is thus made for all minds to an extent impossible under a narrower conception of the scope and relations of learning. The undogmatic candor with which knowledge is imparted is in favorable contrast to the political and ecclesiastical prejudices and prescriptions which have so often impaired the freedom and impartiality, if not the integrity, of academic teaching. That peculiar sentiment, inadequately described in the words "love of truth," whose ethical value is attested by the laborious, self-denying lives so often produced by it, has never been more fully developed among scholars and teachers than it is to-day. The historic method, whose abuse, as leading to intellectual indifferentism, is acutely indicated by Mr. John Morley, — "In the last century men asked of a belief or story, Is it true? We now ask, How did men come to take it for true?" — in its real spirit and in its chief influence, is singularly humane and practical, since it leads us to consider every department of knowledge in its relation to the life of society and the welfare of mankind, and blends in happy and admirable combination the scientific and the philanthropic temper. It may surely be claimed that never in the history of educational institutions have they approached so nearly as now the standard of duty and service indicated by Cardinal Newman: "If a practical end must be assigned to a university course, I say it is that of training good members of society. Its art is the art of social life, and its end is fitness for the world." That aspiring and



ingenuous minds, subjected to the influences which control the schools of learning in our day, will revolt from them with the keen dissatisfaction and bitter sense of injury and loss which so many have felt in the past, it does not seem possible to believe.

President Gilman delivered an address, on the occasion of this anniversary five years ago, upon a subject closely akin to that which has now been presented. His opening words I will quote: "To be concerned in the establishment and development of a university is one of the noblest and most important tasks ever imposed on a community or on a set of men. It is an undertaking which calls for the exercise of the utmost care, for combination, co-operation, liberality, inquiry, patience, reticence, exertion, and never-ceasing watchfulness. It involves perplexities, delays, risks. Mistakes cannot possibly be avoided; heavy responsibility is never absent." This statement, in no wise exaggerating the arduous and responsible nature of the task, may remind us how large a measure of honor and gratitude is due to those who have co-operated in the founding and upbuilding of this university, and especially to him, of whom in his absence we may speak more freely, to whose energy and wisdom and self-devotion the success of these years is, by common consent, pre-eminently to be ascribed.

#### NOTES AND NEWS.

WALLED up in the cellars of a brewery at Burton-on-Trent, there was discovered not long ago some beer which had been brewed in the year 1798. It resembled sherry more than it did a malt liquor, and was in good condition.

—The American Society of Mechanical Engineers have purchased a commodious building at 12 East 31st Street, this city, for permanent headquarters. Part of the building will be occupied by the Institute of Electrical Engineers, and the libraries of both societies will be merged into one.

—Late reports from the engineers at work on the Nicaragua Canal indicate that the preliminary harbor improvements at Greytown are going ahead successfully and rapidly. Senator Warner Miller has been elected president of the construction company, succeeding Mr. A. C. Cheney, who is now vice-president.

—A special train on the Philadelphia and Reading and the Central Railroad of New Jersey, on March 10, made the run between Philadelphia and New York, a distance of ninety miles, in eighty-five minutes. This is at the average rate of 63.53 miles per hour. At times the train is said to have exceeded eighty-five miles per hour.

—The American Tunnel Construction Company have contracted to construct a tunnel under the East River, from New York to Brooklyn, work to begin as soon as the consent of the local authorities shall have been secured. Meanwhile the tunnel under the Hudson, which has passed into the hands of English capitalists, is making slow progress.

—M. D. Bellet contributes to the *Compte Rendu*, 1889, No. 14, a note on some tables furnished by the director of the McGill Observatory, Montreal, to Gen. Greely. The observations extend over fifty years, from 1839 to 1888 inclusive, and form an exhaustive exposition of the climatic conditions of the country. During those years the variations of the seasons have been confined within very narrow limits. The last frosts have occurred at the beginning of May. The earliest spring was that of 1878, when the last frost was on April 2, and the latest was in 1856, in which year the thermometer fell to freezing-point on May 21. The frost, except in 1867 and 1874, always returned before November, the latest recorded being on the 5th of that month, and the earliest on Sept. 15 in the year 1859. In 1860 snow fell on Sept. 29, the only occasion when it fell during that month. Its latest appearance was in 1846, on Nov. 28. In 1839 snow ceased to fall in March, an event which did not happen again until 1889. The latest snow recorded fell on May 27, 1871. Snow fell during this month in only nineteen years out of the fifty. The mean temperature at Montreal during the seven

years 1851 to 1856 inclusive was 41.56° F., the maximum 100.1° F., and the minimum 36° F. During the fourteen years ending in 1888, the mean was 41.58° F., though the last year the mean was only 39.83° F. The mean rainfall for 1851 to 1857 was 43.004 inches, and for the last fourteen years only 27.2 inches; but the figures for the months of July and August, 1888, are the largest recorded. The annual fall of snow for the years 1851 to 1857 was 95.76 inches; for the fourteen years ending in 1889, 125.8 inches.

—The construction of railways was commenced in Japan about twenty years ago; and now 579 miles of line are in working order, of which 497 are in Hondo, and the remainder in Yezo. Some of these lines, according to *Compte Rendu*, 1889, No. 14, belong to the state, others to the Japanese Railway Company. The former run from Tokio to Yokohama; from Yokohama to Kodzu; from Kobe, through Osaka and Kioto, to Otsu on Lake Biwa; from Handa, through Nagoya and Naga-hama, to Tsuruga on the west coast of the island; from Takasaki to Yokokawa; and from Naoyetsu to Sikiyama. The company's lines run from Tokio to Sendai, and from Tokio to Takasaki and Mayebashi. In Yezo there are only two state lines, — the one from Otaru to Sapporo, and thence to the coal-mines of Horonai; the other connecting the sulphur-mines of Kushiro with the river of the same name. Besides the above-mentioned lines, there are in course of construction a line connecting Kodzu and Nagoya, with a branch to the naval station Yokosuka; another from Yokokawa through Nagano to Sikiyama; a branch from the Sendai line to Utsunomiya and Mito; and a line from Koyama to Kiryu, through Tochigi, Sano, and Tatebayashi. Lastly, numerous lines are projected, of which one from Sendai to Aomori, at the northern extremity of Hondo, is among the chief.

—Sir J. H. Drummond-Hay believes that Morocco might export a large quantity of agricultural produce under a just and prudent government, says the London *Chamber of Commerce Journal*. The soil is very fertile, particularly in the southern provinces, and produces wheat, barley, maize, and other grains, cotton, oil, fruits, cattle, etc. The people are strong and intelligent, and the climate more temperate than in southern Spain. But the inhabitants do not care to waste their labor in producing more than suffices for their maintenance, when any surplus there may be is taken from them by the tax-collectors, and any show of wealth attracts the unpleasant attentions of the government officials. The prohibitions and duties on exports also exercise a prejudicial influence on agriculture, as was proved in the case of maize. Sir John Drummond-Hay succeeded in getting the prohibition on the exportation of that grain removed by the convention of 1856. The first year one vessel only was laden with maize, but in subsequent years one hundred vessels were annually laden with it, and a large quantity of fresh land was brought under cultivation. Yet, in spite of the fanaticism of the Sultan's advisers and the unsettled state of the country, trade does to some extent increase. In the years 1875-85 the value of the imports averaged £1,033,918 annually, of which about three-fourths represented British goods. The imports at Tangier in 1887 amounted to £748,000, about £62,000 more than in the previous year.

—M. V. Turquand presented last year a statistical album to the Paris Geographical Society (*Compte Rendu*, 1889, No. 14). It contained, among others, six maps showing the geographical distributions of the different nationalities in France. There are 80,000 Spaniards living in France, most of them in the Basse-Pyrénées and Pyrénées Orientales. It is curious that there are hardly any in Ariège. The Swiss, who also number 80,000, occupy chiefly the basins of the Loire and of the Upper Rhone and Saône. The Italians are spread over the country from the Maritime Alps to Paris, but are most numerous in the départements of the Alpes-Maritimes, Var, and Bouches-du-Rhône. In the first-mentioned they form one-twentieth per cent of the population. The total number of Belgians in France is nearly 500,000: they dwell in the northern half of the basin of the Seine. Lastly, the Germans are found principally along the

frontier, in the departments of the Vosges and the Meurthe. It is a curious fact that the *quartier* of Paris most densely peopled by foreigners of a certain nationality corresponds to the country district where their compatriots are most numerous; for instance, Germans live chiefly in the north-east of Paris as well as of France.

—The arrangements for holding an exhibition in Jamaica in 1891 appear now to be fairly complete. The exhibition is to be opened on the 27th of January, 1891, and to remain open for a period of not less than three months. It will be managed by a commission, of which the Governor of Jamaica is at the head. The exhibition will comprise specimens of all Jamaica products, — sugar of all qualities, and its allied industry of rum-manufacture; liqueurs, cordials, etc.; coffee; oranges, pine-apples, and fruits of all kinds; pimento; cacao, annatto; woods in all degrees of preparation for use; spices, condiments, etc.; fibres and fibrous materials; cinchona-bark, oils, essential oils, perfumes, etc.; medicinal and economic substances; works of art, pictures, fancy articles, and ornamental work; horses, cattle, and live-stock of all kinds. The botany and geology of the island will also be fully illustrated. The exhibition will also contain examples of foreign products imported into Jamaica. The date given for the receipt of applications for space is the 1st of May next. No charge is to be made for space. A guaranty fund of over \$115,000 has been raised in the island; and this, it is believed, will nearly suffice for the purposes required. A committee to insure the due representation of British industries has been formed in London. Mr. Washington Eves, C.M.G., is the chairman; and, at the request of the committee, the Council of the Society of Arts have nominated one of the members, Mr. C. M. Kennedy, as a member of that committee. For further information, application should be addressed to Mr. Washington Eves, 1 Fen-court, E.C., London, Eng.

—Mr. J. L. Shand sends the following extract from a letter from Mr. James Taylor of Tooleconda Estate, dated June 25, 1888, to the *Journal of the Society of Arts*, London, which gives, on undoubted authority, the dates of the first importation into Ceylon of Assam hybrid tea-seeds, and also of its first successful planting. The first tea was sold in Kandy early in 1872, just about the time of the arrival in the colony as governor of Mr. (now Sir William) Gregory, who at once paid a visit to Tooleconda to see what was going on there. Mr. Taylor writes, "The first Assam hybrid tea-seed arrived here in the early part of 1868. That lot all failed, and our second lot came in the first days of 1869, and our clearing of twenty acres was planted with the plants from this seed in the latter part of the same year. Tea was first planted on Tooleconda in 1866 along the roadsides. This was China tea, the seed of which had been got from the Peradenia gardens, and the plants raised here in small nurseries. Our tea-house was built in 1872; but some tea was made for sale before that, and we had been making it experimentally for years before. Our first experiment was about 1866, when an Assam planter passing through showed me how to do the rolling, and told me about the rest of the performance. This was with leaves off old tea-bushes in the garden of my bungalow."

—The richest petroleum districts of Roumania are situated at the south-east of the Carpathian Mountains, where the oil is obtained at five different spots. In many places, especially at Ploiesti, the ground is charged with gas to such a degree that it is only necessary to bore a hole, and a jet of inflammable gas issues at once. The working of the oil, as described in the *Oil, Paint and Drug Reporter*, is conducted in shafts and galleries, the roofs and walls being closed in with boards. The total yield from Walachei amounts to 9,000 tons, and the product contains 20 to 23 per cent of solid paraffine. It is exported to Vienna to a considerable extent, and yields about 15 per cent of petroleum naphtha on refining. The wells are 50 to 70 metres in depth, some as much as 120 metres. Deeper borings and large refineries have been established recently by foreign enterprise, and the output of oil has increased rapidly of late. The oil districts stretch along

the southern side of the Carpathians to an extent at present unknown, in the provinces of Prahova, Dimbowitzza, and Buzen; and the fields appear to be connected with those of Galicia. Two varieties of crude oil are distinguished, — (1) Pacura and (2) Titeiu. The latter contains the material for refining purposes, and yields 78 per cent of burning naphtha. It cannot be imported into Austria-Hungary on account of the high duty, but is freely exported to Germany, where there is no duty on the raw product; and after refining, the lighting-oil can be sold at 18.4 marks per hectolitre, while American oil commands 27 marks (this refers to 1884). The petroleum from Momesti and Casin flashes at 17° to 19° C. (10° below Russian petroleum), and begins to distil at 80°, yielding a large proportion of distillate up to 150°. Roumanian oils from eight districts are described by Istrati (*Jahrbuch des Organischen Laboratoriums zu Bucharest*, 1888-89), and contain from 42 to 65 per cent of photogen, 5 to 20 per cent of petroleum naphtha, and 11 to 25 per cent of solid paraffine. The residues yield nearly 50 per cent of photogen when carefully rectified. A sample from Pacureti (Prahova) yielded 50 per cent of lighting-oil of specific gravity 0.800, and distilling between 125° and 280°. Austrian and American crude petroleum both yield about 50 to 55 per cent of good burning oil, while the Russian product does not give more than 20 per cent.

—Of 122 varieties and seedlings of the potato tested the past season at the Agricultural Experiment Station, Madison, Wis., the following ten were most productive, yielding in the order named: seedling from C. E. Angell, Rose Beauty, Monarch, Duplex, Late Beauty of Hebron, Mullaly, Alexander's Prolific, Seneca Red Jacket, White Beauty of Hebron, and Wisconsin Beauty. Placed in the order of their table quality, these varieties would rank as follows: Alexander's Prolific, White Beauty of Hebron, Late Beauty of Hebron, Duplex, Monarch, Wisconsin Beauty, Seneca Red Jacket, Rose Beauty, Mullaly, seedling from C. E. Angell. The tests made at the station, taken as a whole, favor heavy rather than light seeding. Cutting off the "seed-end" was found detrimental to the yield. No advantage followed sprinkling the cuttings with plaster before planting.

—Dr. Thomas Taylor, microscopist of the United States Department of Agriculture, proposes the following new method of detecting oleo in butter: Dissolve in 20 cubic centimetres of petroleum benzine 140 grains of a mixture of oleo and butter. Heat slightly to secure a perfect solution of the fats. Caseine and animal tissues may be readily removed by passing the liquid while warm through fine muslin. Fill a test tube with the solution, and place in ice-water. In about twenty minutes the oleo-fat will separate from the butter-fat, and fall to the bottom of the tube, being insoluble in cold benzine, while the butter-fat will remain in solution in the benzine. Separate the oleo-fat from the liquid butter-fat by filtration. The fat recovered may be solidified by mechanical pressure, placing it between several layers of bibulous paper to absorb the remaining benzine, after which the sheet of solid oleo may be removed from the paper with a palette-knife. The butter may be recovered by evaporating the benzine by means of a sand-bath.

—Dr. Thomas Taylor, microscopist of the United States Department of Agriculture, proposes the following new method of detecting cottonseed-oil in lard: Dissolve in 20 cubic centimetres of petroleum benzine 140 grains of a mixture of lard and cottonseed-oil. Heat slightly to secure a perfect solution of the lard. Animal tissues should be carefully removed by passing the liquid while warm through fine muslin. Fill a test-tube with the solution, and place in ice-water. In about twenty minutes the lard falls to the bottom of the tube by reason of its insolubility in cold benzine, while the cottonseed-oil remains in solution in the benzine. Separate the lard from the cottonseed-oil by filtration through fine bibulous paper, and subject the recovered fat to mechanical pressure between several folds of the filtering-paper, by which means the remaining benzine is absorbed. The solidified fat may be removed from the paper with a palette-knife. The cottonseed-oil is separated from the benzine by means of a sand-bath, which evaporates the benzine.

## SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES.

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada..... \$3.50 a year.

Great Britain and Europe..... 4.50 a year.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

VOL. XV. NEW YORK, MARCH 21, 1890. No. 372.

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## SHOULD FARMERS RAISE THEIR OWN VEGETABLE-SEEDS?

THIS is a question of considerable importance, and one to which attention is frequently directed by the agricultural journals. It has been made the subject of an experiment by George C. Butz at the Pennsylvania State College Agricultural Experiment Station, with a view to determining some facts that would aid in its consideration. Cultivated vegetables, as a rule, are further removed from their original or "wild" forms by the natural development due to high culture than are the cereals and other ordinary farm-crops: therefore the conditions of soil and cultivation under which vegetables are grown have much to do in fixing the value of the seeds maturing on these plants. We have only to compare the wild carrot of our fields with the cultivated form of the garden to note the change which has been wrought by cultivation. The former is an annual, with a slender root, toughened by much woody fibre; the latter is a biennial, with a fleshy, tender root. It has often been observed, too, that reversions are common among carrots growing in poor soil. These and similar facts concerning other vegetables should not be ignored in considering this question.

Undoubtedly there was a time when many farmers bought commission seeds with but few satisfactory results, for often these seeds were greatly impoverished and adulterated, and reflected much discredit on the seed-business. It is fair to say at this time, however, that the seeds found in country stores, bearing

the names of reputable firms, are quite as good as seeds obtained direct from the warehouses. The results of some tests of such seeds made last year may be found in Bulletin No. 4 of the Pennsylvania station. The germinative value of the seeds thus tested compared very favorably with that of the seeds obtained in bulk. Considered from a financial standpoint, no farmer or gardener can complain about the price of seeds, when for a dollar a full assortment of good clean seed, in quantity sufficient for a family can be obtained. If, however, the farmer tries to save this expense by raising his own seeds, he finds in a few years that his vegetables are not so choice as they once were, because the seeds are not selected with care, and the proper cultivation has not been given to the garden.

The question in its scientific aspect presents itself in the following form: Are seeds which have matured under high cultivation (as on our best seed-farms) better for our less enriched farm soils than seeds which have matured in this poorer soil? The answer must be found in a comparison of results regarding earliness, productiveness, vigor, and quality of the products. The conditions at the station were very favorable to the work, and in 1888 seeds were gathered from the best of those vegetables that seeded. The ground in which they grew is not a rich garden soil, but only an ordinary farm soil. These seeds were planted last year along with seeds of the same varieties from the seed-houses of Landreth, Dreer, Thorburn, and others. In March the seeds were examined and careful weights taken of a hundred seeds of each variety. From the figures in the tables of tomatoes, radishes, and lettuce, it appears that in nearly all varieties of the first two vegetables mentioned the station-grown seeds were heavier than those from the seed-houses, while those of the lettuces in the majority of cases were lighter. Following this examination, a test of the germinative values was made by putting a hundred seeds of each variety in the germinators. These results are slightly in favor of the station seeds in case of radishes, but against them in that of the tomatoes.

The seeds of each vegetable were sown at the same time, and given similar treatment. The beans and tomatoes suffered somewhat from a severe late frost, and hence we cannot attribute much value to the figures on earliness and yield, except perhaps as comparisons under like conditions.

It was observed after the frost, which occurred on the 29th of May, that the plants from station seeds were, as a rule, more seriously affected than the others.

The indications of the tables are, (1) the station seeds were, as a rule, heavier than the purchased seeds; (2) the weight was no indication of the germinative value of the seeds; (3) in the majority of cases the earlier marketable products were obtained from the purchased seeds; (4) the greater yield, with but few exceptions, was obtained from purchased seeds; (5) lettuce from purchased seed produced heads that did not "shoot up" to flower as early as the plants from station seed; (6) radishes from purchased seeds were larger, more tender, and more uniform than those from station seeds; (7) on the whole, the results are strongly in favor of seeds from good soil, however rich that may be.

The experiment will not cease with the present results, however conclusive they may appear, as it is desired to determine how much is lost by several years' use of seeds raised on average soil.

## CLIMATOLOGICAL TEMPERATURE.

IT is well known that the sensation produced by heat and cold of the atmosphere upon the exposed surface of the human body has no direct constant relation to the rising and falling of the temperature in the shade, commonly regarded as the temperature of the external air. When overheated, we fan ourselves or court a draught, and wind produces a like cooling effect. In stagnant air the heat of the tropics is unbearable. In polar regions the cold of winter is unsupportable in high winds. Thus a cooling sensation is maintained by a breeze throughout the thermometrical range of temperature. But, whatever the temperature of the air may be, in sunshine we experience additional warmth, especially if there is little or no wind. Hence our sen-



sations of heat and cold are due not merely to the temperature of the air, but also to the direct solar radiation and the wind's velocity. Upon this basis, Mr. J. Vincent, the Belgian meteorologist, as we learn from *Engineering*, has experimented on the temperature of the exposed surface of the human body, as the hands and face, and given an account of his investigation in *Ciel et Terre* under the title "Climatological Temperature." A long series of observations has conducted him to the formula, adapted to Fahrenheit's thermometer,  $\frac{99.7 - A}{S - A} = 1.42$ , whence  $S = 70.3 + 0.3 A$ , where  $99.7^\circ$  is the interior temperature of the human body;  $A$ , the temperature of the air;  $S$ , the temperature of the exposed skin when in shaded and calm air. Let  $E$  be the excess of solar radiation above the temperature of the air,  $V$  the velocity of the wind in miles per hour; then  $C$ , the climatological temperature, or the temperature of the skin, as influenced by  $A$ ,  $E$ , and  $V$ , is

$$C = 70.3 + 0.3 A + 0.2 E - \sqrt{4.34 V}.$$

Thus, if  $A = 48^\circ$ ,  $E = 4^\circ$ ,  $V = 20$  miles, then  $C = 76.3^\circ$ , and this is the temperature of the exposed skin; whereas in calm air it would have been  $85.5^\circ$ , and in calm and shaded air  $84.7^\circ$ . Here the effect of sunshine is very small. It is often very considerable. Observations carried out in this manner during December, 1889, show that the thermometrical coldest day,  $20.8^\circ$ , was the 3d; the warmest,  $48^\circ$ , the 24th; whereas the greatest sensation of cold,  $71.4^\circ$ , was due to the 9th; of heat,  $88.8^\circ$ , to the 15th. Although the air was not so cold on the 9th as on the 3d, it felt colder because there was no wind; and although the 24th was much warmer than the 15th, the 15th felt warmer because there was much less wind and powerful sunshine. The observations were made at noon. The investigation is exceedingly curious and interesting; gives a direct utility to observations of solar radiation; and, without doubt, ought to enlist the attention of meteorologists, and be carried out more extensively, for which purpose the original memoir must of course be consulted.

Probably it will be found that these relations are only tolerably identical in healthy subjects; for physiological and pathological influences, as well as those of the weather, determine the bodily sensations. This investigation, however, clearly makes manifest that our individual bodily experience is in several respects quite a different meteorological indicator to the unsentimental thermometer.

#### KILIMA NJARO.

THIS mountain, as is well known, consists of two summits, the Kibo and the Kimawenzi, connected by a saddle studded with hills of lava. From this saddle Dr. Meyer tried, in 1887, to scale the Kibo (*Scottish Geographical Magazine*), but had to give up the attempt on account of the weather. Last October he pitched his tent on the saddle, at an elevation of over 14,000 feet, and on the 3d of the month set forth at half-past two in the morning, accompanied by Herr Purtscheller, and provided with the usual equipment of the Alpine climber. During the darkness they made their way to the glacier valley which descends from the flanks of Kibo in a south-easterly direction, and at dawn stood on the rocky northern boundary, looking down into the valley nearly 500 feet below. Crossing this valley, the climbers reached the ridge of lava forming its southern boundary, up which they purposed to make their way to the summit of Kibo. Here they met with the first patches of snow, lying under the protection of the rocks at an elevation of 16,400 feet.

Their route now led over blocks of stone and heaps of *débris*, up the steep lava ridge,—a toilsome way,—where they had to make frequent halts to recover their breath, for the rarity of the atmosphere became more and more perceptible. Shortly before ten o'clock they came to the lower edge of the icy mantle which encircles the summit and conceals it from view. The height of this spot was about 18,270 feet. The rocky declivity over which the climbers had ascended had an inclination of  $30^\circ$ ; the icy wall which rose above it,  $35^\circ$ . Dr. Meyer and his companion found it very exhausting work to scale this slope, cutting steps, as they advanced, in the ice, which, far from being

firm at the bottom, became still more unsound and uneven as they ascended. At length the crevasses were crossed, the highest undulation of the ice visible below was surmounted, and at a quarter to two o'clock the climbers stood on the edge of the crater. Here they perceived that the highest point of the crater wall lay about one and a half hours' march to their left on the southern side. Weary as they were, they did not venture to run the risk of being caught in a fog, or of being obliged to bivouac on the mountain-side without any protection against the cold. They therefore turned back, and, after a day of sixteen hours, reached their camp on the saddle, congratulating themselves that at any rate the true nature of the summit had been discovered. Three days later they again went forth, and passed the night in a cave they had remarked in the right side of the glacier valley, whither Dr. Meyer's negro follower carried their blankets, etc. No fuel could be procured; but, considering the elevation, 15,150 feet, the night was mild ( $10.5^\circ$  F.), for their bivouac was sheltered from the wind blowing over the glacier. Starting at three o'clock, the climbers reached the point where they turned back on the former occasion, at a quarter to nine. Its elevation above the sea-level was 19,220 feet. Beyond this point no great difficulties were encountered.

The edge of ice which runs round the crater slopes gradually up towards the south, where it is pierced by three peaks. It was impossible for the eye to decide which of these three was the highest, and therefore Dr. Meyer ascended all three, and found that the middle one was 50 to 65 feet higher than the others. This, the highest point in German territory, being somewhere about 19,680 feet above the sea-level, he named "Kaiser Wilhelm Spitze." From this position the crater could be well observed. Its diameter is about 6,500 feet, and it sinks to a depth of 650 feet. On the north and east the ice descends from the edge inwards in steep terraces, while on the west and south lava precipices take its place. A little to the north of the centre a slightly arched eruptive cone, composed of dark-brown ashes, rises to a height of 490 feet above the crater bottom. Its upper portion is bare, but its base is covered by a mighty glacier which escapes from the crater through a cleft in its western side.

About a fortnight later Dr. Meyer visited the northern side of the mountain, where he found the ice mantle much narrower than on the other side, beginning at an elevation of 18,820 feet, but so steep and hard that only experienced mountaineers would be able to cross it. He also descended through the great eastern cleft into the crater itself. Dr. Meyer also made several expeditions up Mawenzi, or Kimawenzi. It is evident that a much longer period has elapsed since this crater became extinct, for the whole mountain is riven, eroded, and degraded in a marvellous manner, so that it is both difficult and dangerous to climb over its rocks. Dr. Meyer considered it vain for two men to attempt the ascent of the highest pinnacle, but he reached the top of another not much lower, which he found to have a height of 17,250 feet. Towards the east the flanks of the mountains sink precipitously. The lava is so friable, and has been so much denuded by wind and rain, that the mountain is reduced to a mouldering skeleton. It is a mass of turrets, pinnacles, pyramids, and battlements, intermingled with heaps of detritus.

#### BOOK-REVIEWS.

*Sound-English. A Language for the World.* By AUGUSTIN KNOFLACH. New York, Stechert. 12°. 25 cents.

THIS is another attempt at spelling-reform. The author justly holds that the English language, by its simple structure and its extensive and rapidly increasing prevalence, is entitled to become the universal language for international communication. But the present orthography of English is an insuperable obstacle to its adoption as the world-language, and this obstacle can only be removed by a phonetic spelling. Apparently, also, he is not satisfied with the phonetic systems that others have proposed, though he offers no criticism of them. His own system has three essential points, though some of them are not peculiar to it. He

gives most of the vowel letters their Italian sound, and proposes to introduce at first five new letters, to be followed by six more at a later time. But the chief peculiarity of his system is the "strengthening" of the vowels to denote their long sound. This is done in printing by the use of full-face type, thus, "uphold," and in writing by a heavier shading of the letter. This, as it seems to us, will be an insurmountable obstacle to the adoption of the system; for who will take the trouble, in rapid writing, to shade now and then a letter more heavily than the rest? Moreover, we gravely doubt if any system can be brought into use that contains new letters; and, if new letters are to be introduced, there are other systems that have quite as good a claim to be adopted as Mr. Knoflach's.

*On the Relative Advantage of Tubs with Bottoms and Tubs without.* Printed for the author. New York, for sale at 20 Cooper Union. 12°.

THIS anonymous work consists of two parts, the first being in the main a polemic against the views now held by many of the Swedenborgian clergy, and the second a statement of the author's own views. He maintains that the professed followers of Swedenborg misunderstand or misinterpret the doctrines of their master, and in particular he condemns their pantheism, which he thinks Swedenborg would have regarded with aversion. In this polemic against pantheism he makes some good points. He affirms also that the doctrines he criticises have no rational basis, they are tubs without bottoms; while the real doctrines of Swedenborg, as the author of this book understands them, have a basis that is all-sufficient. He then proceeds to state some of these doctrines in a simple and popular way, the leading one being a mystical interpretation of the doctrine of the Trinity. Every thing that exists, he tells us, consists of three elements, — substance, form, and force; and of these elements he says, that, though "essentially different, they yet shall have a common name, 'person,' for each is a person." He then goes on to maintain that in the Divine Being substance is the Father, form the Son, and force the Holy Spirit. Such, according to our author, is the true doctrine of the Trinity, and the highest principle of religion. We greatly fear, however, that this tub also has no bottom, for we can see no rational basis for such mysticism. The author expresses himself well, and with greater simplicity than most writers on such topics, and his work will doubtless have an interest for Swedenborgian readers; but to other men it is not likely to be of much use.

*The Way out of Agnosticism.* By FRANCIS ELLINGWOOD ABBOT. Boston, Little, Brown, & Co. 12°. \$1.

THIS book consists of a series of papers based on lectures delivered at Harvard College, and originally published in the *New Ideal* newspaper. They are in the main a briefer and simpler statement of the views expressed in the author's "Scientific Theism." The introduction is a lively attack on the agnostics for maintaining a purely negative attitude, and refusing to make any attempt toward a positive theory of the universe. Mr. Abbot justly holds that mankind can not and will not remain without such a theory, and declares that the liberalism of the present day, on account of its negative character, is "infinitely inferior to the Christian mythology which it has displaced." Yet he maintains that liberalism alone can furnish the true constructive theory of the universe which is now so greatly needed, and his own aim is to present the outlines of such a theory.

As his theory has already been given to the public in his earlier and larger work, we need not devote much space to an analysis of it. His leading doctrines are these: 1. "The universal results of the special sciences, including the method common to them all, are the only possible data of philosophy or universal science." 2. "The universe is known as at once infinite machine, infinite organism, and infinite person, — as mechanical in its apparent form and action, organic in its essential constitution, and personal in its innermost being." This theory, in its identification of the deity with the universe, is pantheistic, but in affirming the personality of the deity, it is opposed to pantheism. Another of Mr. Abbot's essential doc-

trines is his realism, which he maintains in opposition to the phenomenalism or idealism of the prevailing modern philosophies. The book is written in a vigorous style; and, whether one agrees with its doctrines or not, it is interesting to read.

#### AMONG THE PUBLISHERS.

W. A. LINN's article on "Co-operative Home-Winning," through building associations, will appear in the May *Scribner*.

— Henry Holt & Co. will publish soon "Introduction to Systematic Botany," by Charles E. Bessey, professor in the University of Nebraska, and author of Bessey's "Botanies" in the American Science Series.

— The last issue of *Garden and Forest* presents a complete list of the works treating of landscape-gardening which have been published in English, French, German, and Italian since 1625, the date of Lord Bacon's famous essay. It includes not only all books and pamphlets, but all articles and reviews on the subject, and covers nearly five closely printed pages. To make room for this list, which is a work of permanent value, the paper has been enlarged, and contains, besides an illustration of Clermont on the Hudson, with a description by Charles Eliot, its usual amount of matter in the various fields of horticulture and forestry.

— Frederick W. Whitridge, the well-known New York lawyer, who contributes an article to the April *Scribner* on "The Citizen's Rights as a Householder," tells the following story: "The series of papers upon the rights of citizens, of which this is the first, happened lately to be mentioned before a person of ripe and sound judgment, who has seen much of the world, but who is not a native of this Monte Cristo of nations; and this person, illuminated by the knowledge of many cities and men, thereupon exclaimed, 'Rights of citizens! You Americans haven't got any rights; or, if you have, you are all so afraid of each other, you dare not assert them.'"

— A curious phenomenon, in virtue of which electric cars are aided in ascending heavy grades, is alluded to by Joseph Wetzler in his article on "The Electric Railway" in the April *Scribner*. This phenomenon, which was probably first observed by Leo Daft, at his works in Greenville, N.J., in 1882, is, that, when the current passes from the car-wheel to the track, it causes an increased friction or resistance to sliding between them, the result of which is that slipping is to a large degree prevented, and heavier grades can be attempted. The explanation of this phenomenon, though not completely established, seems to lie in the direction of a slight welding action which takes place between the wheel and the rail, caused by the heat generated by the current.

— Messrs. Griggs & Co. of Chicago have published "Semitic Philosophy," by Philip C. Friese; and a singular book it is. The author professes to have the only true interpretation of Christ's doctrine of the kingdom of God, claiming that it is known "instinctively;" and he here gives a statement of the doctrine and its practical applications. He presents to us "so much of the unwritten, instinctive, rational, ideal, or natural constitution of the kingdom of God, or universal society of the races of mankind, as may, when universally assented to and adopted by tacit or express general agreement, be established as such in writing." It is drawn up in articles and sections like the Constitution of the United States, and provides for a republic of letters, a republic of the Church, a republic of industry, a republic of charity, and a republic of government, the organization and functions of each of which are duly set forth. What it all amounts to, we are unable to see. The book is a curious compound of crude social projects and hazy metaphysics, and that is all we can say for it.

— The opening article of *The Chautauquan* for April is by Professor James A. Harrison, Ph.D., LL.D., of Washington and Lee University, on "The Archaeological Club in Italy;" "Life in Modern Italy," by Bella Stillman, follows; the eminent philologist, Professor Federico Garlanda, of the University of Rome,

Publications received at Editor's Office,  
March 10-15.

- ALLEN, G. The Colours of Flowers as illustrated in the British Flora. London and New York, Macmillan. 12°. 119 p. \$1.
- BRINTON, D. G. Essays of an Americanist: I. Ethnologic and Archaeologic; II. Mythology and Folk Lore; III. Graphic Systems and Literature; IV. Linguistic. Philadelphia, Porter & Coates. 489 p. 8°. \$3.
- FLOWER, W. H. Fashion in Deformity as illustrated in the Customs of Barbarous and Civilized Races. London and New York, Macmillan. 85 p. 12°. 50 cents.
- HICKS, W. M. Elementary Dynamics of Particles and Solids. London and New York, Macmillan. 397 p. 12°. \$1.60.
- LIEBIG, G. A. jun., and ROHÉ, G. H. Practical Electricity in Medicine and Surgery. Philadelphia and London, F. A. Davis. 383 p. 8°. \$2.
- LONGFELLOW Leaflets. Compiled by Josephine E. Hodgdon. Boston and New York, Houghton, Mifflin, & Co. 108 p. 12°. 30 cents.
- SENSENG, D. M. Numbers Universalized: An Advanced Algebra. Part Second. New York, Boston, and Chicago, Appleton. 178 p. 12°.
- SMITH, J. Dictionary of Popular Names of Economic Plants. London and New York, Macmillan. 457 p. 8°. \$3.50.
- STEVENS, F. H., ed. The Eleventh Book of Euclid's Elements. Propositions 1-21. London and New York, Macmillan. 48 p. 16°. 30 cents.
- TUBS with Bottoms and Tubs without, On the Relative Advantage of: being a Rambling Letter from a Cooper's Apprentice to a Swedenborgian Clergyman. New York, 20 Cooper Union. 345 p. 12°.
- WENDEL, F. C. H. History of Egypt. New York, Appleton. 158 p. 16°.

**HEAVEN AND HELL.** By EMANUEL SWEDENBORG. 416 pages, paper cover. Mailed pre-paid for 14 Cents in stamps by the American Swedenborg Printing and Publishing Society, 20 Cooper Union, N. Y. City.

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writes of "The Indebtedness of the English Language to the Latin;" Professor Adolfo Bartoli begins a series on "Italian Literature;" "The Politics of Mediaeval Italy" are considered by Professor Philip Van Ness Myers, A.M.; Principal James Donaldson, LL.D., of the University of St. Andrews, Scotland, contributes his second paper on "Roman Morals;" Albert Shaw, Ph.D., predicts a hopeful future for "Rising Bulgaria;" a new realm of investigation open to the physicist is discussed by Professor Edward L. Nichols of Cornell University, in "The Production of Artificial Cold;" the English writer, Arabella B. Buckley, continues her studies on the "Moral Teachings of Science;" and Mrs. Carl Barus does the same with "What are our College Women Doing?" New to most readers will be the information in the article, "A Botanical Garden in the Island of Java." "A Study of Spiritualism" likely to attract attention is contributed by a member of the Seybert Commission, Robert Ellis Thompson, of the University of Pennsylvania. The usual space is given to editorials and C. L. S. C. matters.

—The March *Magazine of American History* contains a chapter, "Celebrating the Birth of William Bradford," by Thomas Bradford Drew of Plymouth, taking us backward to the first settlement in New England; then we find some personal memories from the pen of Hon. Charles K. Tuckerman, writing from Italy on "Sir John Bowering and American Slavery." We have an account by W. R. Garrett, A.M., of the controversy concerning "The Northern Boundary of Tennessee," which stretched over sixty-eight years, and is interesting just now in view of the boundary suit recently instituted by Virginia against Tennessee in the Supreme Court of the United States; and entertainment is given in "Hawthorne's First Printed Article," by Kate Tannett Woods. "The Story of the Greatest Auditing Office in the World," by Milton T. Adkins, is statistical, but desirable to possess and preserve; and the "Neglected Grave of Seth Pomeroy," by Frank Sutton, will awaken sympathy. The leading illustrated paper of the number is a picture of "Life in New York Fifty Years ago," by the editor. The period reproduced opens with the completion of the Erie Canal; and glimpses are given, through the diary of an old New-Yorker for twenty-five years, of characters and affairs, of inventions, politics, and panics, of clubs, dinners, fancy balls, and foreign visitors. Dickens was here, and, being then regarded as the greatest living novelist, was feted and complimented beyond any other writer of his generation.

—Messrs. Ginn & Co. announce to be published in April or May, "Directional Calculus," by E. W. Hyde, professor of mathematics in the University of Cincinnati. This work follows in the main the methods of Grassman's "Ausdehnungslehre," but deals only with space of two and three dimensions. The first two chapters give the theory, and fundamental ideas and processes, of Grassman's admirable and comprehensive geometric method, with sufficient fulness and completeness, it is believed, to enable the student to pursue the subject satisfactorily through the remaining chapters, containing applications to plane and solid geometry and mechanics, or to enable him to read with comparative ease Grassman's original works. A very elementary knowledge of trigonometry, the differential calculus and determinants, will be sufficient as a preparation for reading this book. It is the hope of the author, that, by providing a textbook on this subject in English, he may contribute in some measure toward a more general study and knowledge of that wonderful mathematical system which, though published by its discoverer in 1844, has met with the most remarkable indifference and neglect at the hands of mathematicians up to the present time.

—Interest seems never to be lacking in the controversy over the relative value of realism and idealism in the researches of natural science, and those who insist upon using the "subjective" method of investigation in studying phenomena of the "objective" work are still severely criticised. S. C. Griggs & Co. have now in press, and will issue at an early day, "The World Energy and its Self-Conservation," in which the author, W. M. Bryant, reasoning from the standpoint that "truth in its

vital reality is to be attained only through a complete blending of these two methods," discusses the deepest questions of science.

—Briefly stated, the results of the inquiry by W. E. Stone regarding the saccharine substance in the sweet potato, reported in the February number of *Agricultural Science*, are these: the saccharine substance of the sweet potato exists chiefly, if not entirely, in the form of sucrose; the use of the polariscope in the quantitative determination of the same seems possible (such determinations showed one and a half to two per cent of sucrose in the fresh potatoes); the temperature of cooking (baking) inverts the sucrose and converts more or less of the starch into a soluble form. A part of Mr. Stone's investigation was made at the laboratory of the Tennessee Experiment Station, the remainder at Purdue University.

—"The Scratch Club," by Hugh A. Clarke, Mus. Doc., professor of music in the University of Pennsylvania, has been issued by the Poet-Lore Company, Philadelphia. Under the title of "The Scratch Club," the author has given a lively record of the meetings of an imaginary group of musicians, who discuss music and kindred subjects, and tell stories, some grave, some gay, forming a sort of musical "Tales of a Wayside Inn." Musical taste in America, Handel's "Messiah," Beethoven's "Aurora" Sonata, music in the public schools and in the churches, international copyright, and bad music, are some of the subjects touched upon in the course of these animated conversations.

—We learn from *The Scottish Geographical Magazine* that a new and corrected edition of the topographical map of France, which was commenced in 1818, will shortly be issued. The map printed from the original copperplates is now, of course, out of date; but to alter these large plates is a work so tedious, that it has been put off as long as possible, new roads, etc., being marked on the zincographic edition. The latter process, however, lacks the clearness and sharpness of copperplate engraving; and therefore the Service Géographique de l'Armée, presided over by Gen. Derrécagaix, is engaged in correcting the original plates. In the new edition, alterations and extensions of roads and railways will be duly marked, the towns be enlarged to their present size, the spelling of names corrected, and even fortification works will appear. The unwieldy sheets will be divided into four sections each, measuring 40 by 25 centimetres (about 15½ by 9½ inches). Each section will be sold for 50 centimes.

—Lieut.-Col. Sir Andrew Clarke delivered an address before the London Chamber of Commerce on Nov. 6, 1889 (*Chamber of Commerce Journal*, Dec. 5, 1889), in which he demonstrated the remarkable rapidity with which the British protected states have developed. The foreign trade of Perak has increased from £248,796 in 1876, to £3,134,685 in 1888; and the little state of Selangor, with an area of about 3,000 square miles, which in 1873 had practically no trade at all, exported and imported in 1888 goods to the value of £2,372,756. Revenue and population have correspondingly increased. The twenty miles of railway opened in Selangor in 1887 pay a dividend of 25 per cent, and the eight miles completed in Perak in 1888 pay 8½ per cent. These railways are now being extended, and will promote the prosperity of the country, and yield a satisfactory dividend. Half the tin in the world is exported from these states, and there is a large auriferous region, watered by a navigable stream. The agricultural prospects are equally bright. Perak can produce coffee of fine quality, and yields abundance of pepper and nutmegs. Selangor grows coffee, pepper, tea, and tapioca; indigo has been successfully tried; and land has been granted for the cultivation of tobacco. In Sungei Ujong, 35,871 acres are already under cultivation, and good crops of coffee are produced. Pahang, which has only recently been received under British protection, has hardly been exploited at all; but it will probably prove to be the richest of all these states. Besides its mines, it has fine timber, and most tropical products have been grown in small quantities.

—The discussion on anonymity in journalism will be continued in the *March New Review* (New York, Longmans), with extracts from letters by Labouchere, Lang, Justin McCarthy, Grant Allen, and others; and Mr. Allen also contributes an article on the "Origin of Animals."

— "Motive Power for Street-Cars" is the title of a book published by the John Stephenson Company of this city. The volume is made up mainly of extracts from the proceedings of a recent meeting of the American Street Railway Association. It is handsomely illustrated.

—Harper & Brothers have just issued the second volume of "What I Remember," by the octogenarian novelist Thomas Adolphus Trollope, the elder brother of the late Anthony Trollope. The first volume, which was published about two years ago, closed with the death of Mr. Trollope's first wife in 1865; the new volume covers the period from that date to the year 1889. Among the well-known people with whom the reader becomes acquainted in these pages are Liszt, Von Bulow, Gen. Sheridan, King Humbert, Pope Leo, Salvini, Ristori, Cardinal McCloskey, Jenny Lind, Lanciani, and Holman Hunt.

—Messrs. Ginn & Co. announce "Open, Sesame!" edited by Mrs. B. W. Bellamy and Mrs. M. W. Goodwin. This book is a collection of prose and verse, comprising more than a thousand selections carefully edited, and arranged for committing to memory. It is in no sense an elocutionist's manual, the editors having made the first test of each selection "Is it worth learning?" and the second, "Is it adapted to recitation?" The book is representative of English literature, and also comprises many translations from foreign sources. Its various departments contain many of the familiar classics, and also many extracts from late literature never before included in such a collection. It is arranged in three volumes, each complete in itself, and specially adapted to the age for which it is intended. Volume I. is designed for children from four to ten years old; Volume II., for those from ten to fourteen; and Volume III., for the oldest students. The purpose of the book is to train the memory, to educate the literary taste, and to supply the student with the long-needed standard collection of poetry and prose for recitation.

—The Scientific Publishing Company, P.O. Box 1833, New York, announce the publication of "Gems and Precious Stones of North America," by George F. Kunz, gem expert with Tiffany & Co. This book is a popular description of their occurrence, value, history, and archæology, and of the collections in which they exist, with a chapter on pearls. The standing of the author will serve as a guaranty for the excellence of the work. The several species and varieties of precious stones are described systematically, and the work is far more detailed and thorough than has hitherto been attempted. This magnificent work is profusely illustrated with the finest colored plates ever engraved for a work of this kind, being the very best work of Messrs. Prang & Co.

—In *Garden and Forest* for March 19, Mr. Charles Eliot continues his series of articles on old American country-seats, with a delightful sketch of Montgomery Place; and this fine old home of the Livingstons is illustrated by a view of its entrance front, and another of an avenue on the grounds. The same number contains articles on street trees, the dwarf Japanese plants at the Paris Exposition, the winter colors of the bark of trees and shrubs, and the cultivation of strawberries, besides much seasonable information concerning the garden in early spring.

#### LETTERS TO THE EDITOR.

\*.\* Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

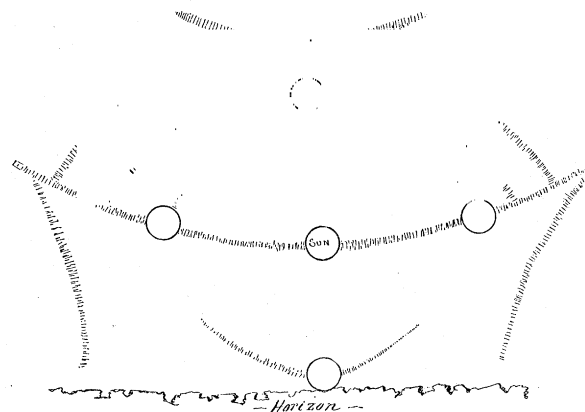
On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

#### Solar Halos.

THE forenoon of March 2 in central and southern Arkansas was cold and calm, and the sky was cloudless though somewhat hazy. About eight o'clock white and colored bows appeared in the haze

about the sun, and continued to be visible until about half-past ten, when it gradually disappeared. This phenomenon seems to have been most brilliant in the south-western part of the State. One of my assistants on the Geological Survey of Arkansas, Mr. James Perrin Smith, who witnessed it in Howard County, Ark., sends me the figure accompanying this (made on the ground), and a letter, a part of which I append.

Mr. Smith writes from Venetia Grove, Howard County, Ark.: "At 8.30 there was not a cloud in sight, but the eastern sky had a hazy appearance. The sun was shining with full brilliancy; and on the right and left of it, and above it at equal distances, three other suns appeared, shining almost as brightly as the sun



proper. The figure called for a fourth secondary sun, but it was too near the horizon for this to be seen. Radiating from these suns were brilliant rainbows forming regular spherical triangles. The brightness of the suns and bows lasted but a few minutes, and then began gradually to fade. Within fifteen minutes, however, the sun had risen high enough to bring the fourth secondary sun to view, but by this time the rainbow lines with it were very indistinct. By ten o'clock the whole spectacle had faded away."

JOHN C. BRANNER.

Little Rock, Ark., March 10.

#### Lake and River Temperatures.

A SERIES of temperatures of the water taken during last summer near the outlet of Lake Ontario and in the St. Lawrence and other rivers by the writer, and during the last and previous seasons in the Georgian Bay by Staff Commander Boulton, R.N., appears to establish some interesting results, which will be detailed in the forthcoming number of the *Canadian Record of Science*. While some of the results are not novel, they all exemplify some characteristics of fresh water in the great masses in which it occurs in the Great Lakes and the St. Lawrence and its tributaries, under the varying conditions of climate which the geographical position of these lakes and rivers presents. The points of interest are,—

That the Georgian Bay, as well as Lake Superior, forms a great area of cold water,—apparently considerably colder at the bottom than even the deeper parts of the central basin of Lake Huron, and varying in July and August between 37.75° and 39.5° F.

That the occurrence in midsummer of a temperature at the bottom of the Georgian Bay, below that of water at its maximum density, is remarkable, and may be due to strong bottom currents.

That the waters of the lakes and St. Lawrence flow onward in areas of different temperatures; the variation being generally from 1° to 3°, and being equally observable under as well as at the surface.

That the general rise in the temperature of the Lake Ontario waters, as the summer advances, is at first slow, compared with the general rise in the temperature of the air; but, as midsummer is reached, the rise is more rapid.

That motion in water, as in a long rapid, appears to at least sensibly raise its temperature. Continuous strong currents, on



the other hand, tend to equalize the temperature even to a depth of forty fathoms.

That the temperature of the water of the main channel of the St. Lawrence is always considerably lower than that of the waters nearer shore, or of the harbors or the affluent streams.

That no general rule can be laid down regarding the changes of temperature with the increase of depth, each case being influenced by its own special circumstances.

That in high summer temperatures the surface of comparatively still, shallow, sheltered water, unaffected by main channel cur-

rents, absorbs and retains heat to a much greater degree than the immediately overlying air; the difference depending on the surroundings, but being in one instance as high as 11°.

A. T. DRUMMOND.

Montreal, Can., March 12.

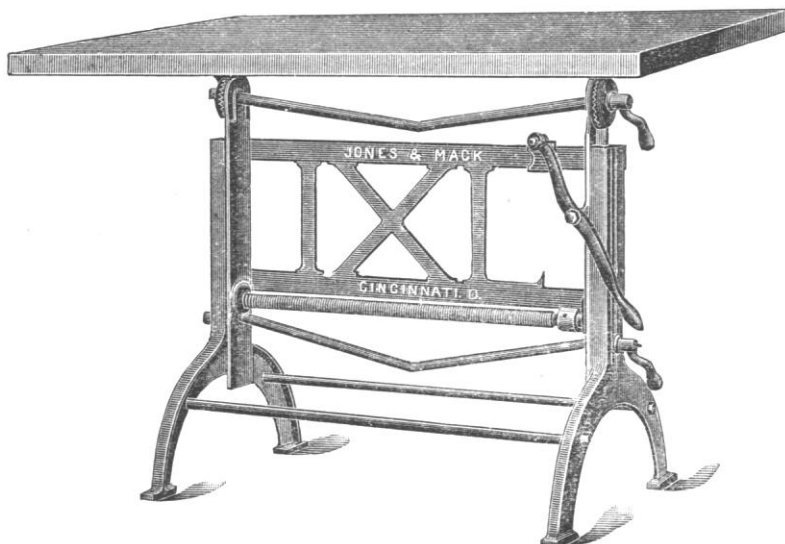
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